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Aspects of Self-Awareness in Meditators and Meditation-Naïve Participants: Self-Report Versus Task Performance

Ivan Nyklíček¹

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Abstract

Objectives Meditation may be viewed as a way to enhance mindfulness and self-awareness. To date, most studies have relied on instruments based on self-evaluations. The aim of this study was to explore aspects of self-awareness in experienced meditators compared to non-meditators using a multi-method approach.

Methods Thirty-five experienced meditators and 47 matched control participants completed tests ranging from self-report questionnaires of mindfulness skills and psychological mindedness to emotion reports in a scenario task and a behavioral task in which spontaneous momentary experiences are verbally reported.

Results Compared to controls, meditators scored higher on self-reported introspective interest and mindfulness skills, but not on emotional awareness. Meditators also showed higher interoception scores during the spontaneous verbal reports task. Interestingly, while mindfulness/Vipassana meditators scored lower on a self-reported mindfulness skill compared to transcendental meditators, they reported more momentary interoceptive and exteroceptive phenomena during the task, the differences being large.

Conclusions Different methods assessing complementary aspects of self-awareness show partially mutually opposing results when meditator and non-meditator groups are compared. These results indicate the added value of behavioral tasks when assessing awareness-related phenomena.

Keywords Awareness · Consciousness · Introspection · Meditation · Mindfulness

Meditation is a concept that is difficult to define. Scholars use different definitions, with different emphases (Bond et al. 2009; Cahn and Polich 2006; Walsh and Shapiro 2006). Taking aspects from these previous definitions into account, meditation is conceptualized as a self-applied practice of training attention and awareness, without analysis or evaluation of the process or result, to enhance general well-being and/or specific capacities such as calm, concentration, and insight. When categorizing meditation types, a main distinction may be made between (i) meditation practices focusing attention on a specific object, such as a mantra or specific bodily or sensory sensations, and (ii) practices involving a more open monitoring of any phenomena that may take place in the pres-

ent moment (Cahn and Polich 2006; Lutz et al. 2008). These two types have been shown to be related to different neuro-physiological concomitants (Lutz et al. 2008; Travis and Shear 2010).

Both types of practice are often used in various meditation traditions, such as yogic meditation traditions, Zen, Vipassana, and Tibetan Buddhist traditions, as well as more popular and clinical applications, such as mindfulness-based stress reduction (MBSR) (Kabat-Zinn 1990). An important aim of these techniques is some form of reduction of stress or suffering, ranging from partial reduction to complete abolishment as in Buddhist approaches (Ekman et al. 2005; Kabat-Zinn 1990; Thera 1972).

In the many Buddhist traditions, by systematic meditative introspection, one practices a “clear and single-minded awareness of what actually happens to us and in us at the successive moments of perception,” which is a “purely receptive state of mind” (Thera 1972) (p. vii–viii). Because this awareness is a central aspect of meditation training, it seems important to be able to measure aspects of such awareness in research into the

✉ Ivan Nyklíček
i.nykliecek@tilburguniversity.edu

¹ Center of Research on Psychological and Somatic disorders (CoRPS), Department of Medical and Clinical Psychology, Tilburg University, Tilburg, Netherlands

effects of meditation training. Such receptive awareness may be seen as distinct from the more reflexive forms of self-awareness, such as “reflection” (Trapnell and Campbell 1999) and the public self-consciousness aspect of self-consciousness (Fenigstein et al. 1975). In these forms, one actively is reflecting upon the phenomena observed during introspection, whereas meditative introspection is pre-reflexive; it just “offers a bare display of what is taking place” (Shear and Jevning 1999) (p. 204). It follows that self-report evaluations may have a difficulty to adequately assess this pre-reflexive form of awareness. It can be argued that any kind of self-report in which participants have to evaluate their own functioning involves a reflective component. Nevertheless, self-report instruments are the most widely used kind of instruments, and they have also advanced the field of self-awareness research. An example is the subfield of mindfulness research.

While there is some debate on the exact definition of mindfulness, most use a one- or two-component definition: (i) paying attention to and being aware of phenomena taking place in the present moment (Brown and Ryan 2003; Thera 1972), often expanded with (ii) in an accepting or nonjudgmental way (Baer et al. 2006; Bishop et al. 2004; Kabat-Zinn 1994). Various self-report instruments have been developed and used in research, some of which unidimensional, others multidimensional. This has greatly advanced research into the topic of mindfulness, as meaningful associations with other constructs have been reported; the self-report measures have shown sensitivity to change during mindfulness interventions (Baer et al. 2004; Baer et al. 2006; Brown and Ryan 2003) and to mediate the effects of mindfulness interventions on psychological well-being (Bränström et al. 2011; Nyklíček and Kuijpers 2008). Nevertheless, an important question is to what extent one is able to evaluate the extent to which one is aware of present-moment phenomena in an unbiased way (Grossman 2008, 2011). Studies comparing (experienced) meditators to non-meditators regarding their self-reported mindfulness usually find differences between the groups (Baer et al. 2008; Brown and Ryan 2003; Lau et al. 2006; Walach et al. 2006), although not always (Baer et al. 2008). Therefore, multi-method assessments, including performance-based measures assessing actual behavior, are recommended to have a more complete picture of mindfulness and related self-awareness phenomena (Baer 2016).

As outlined above, momentary introspective monitoring as practiced in many meditation forms is expected to result in enhanced awareness of phenomena taking place in the moment. Therefore, it is important to examine if this would be reflected in differences between groups of meditators and meditation-naïve participants regarding different measures assessing self-awareness-related constructs. Besides self-report evaluation measures, an imaginative scenario task assessing emotional awareness and a behavioral verbal report

task assessing spontaneous momentary stream-of-consciousness phenomena have been used to examine potential differences between these different methods.

Regarding the latter method, the challenge is to find an appropriate task, which would reflect awareness of present-moment phenomena similar to awareness as trained in most forms of introspective meditation training. In both concentrative and open monitoring meditation, the practice usually involves awareness of all momentary phenomena, albeit in many meditation practices, some phenomena receive more attention (often interoceptive sensations, such as related to breathing), while others may be only monitored to become aware of and return to the object of the primary focus. These forms of attention training, which usually occur in a stimulus-free environment, are supposed to counteract the habitual tendency to wander off into automatic thinking when resting, facilitating awareness of perceptual phenomena (Schooler et al. 2011). Therefore, the behavioral task preferably should assess awareness of (i) all kinds of phenomena, including the often important interoceptive ones (ii) taking place in the successive ongoing moments, (iii) in a spontaneous way, i.e., not triggered or interrupted by stimuli, and (iv) in an unbiased way, i.e., not prompted toward a certain response. Finally, it should be possible to obtain scores on the task, resulting in a quantitative variable.

In previous work in different research areas, methods have been developed that may fulfill some of these criteria. The popular experience sampling or ecological momentary methodology is typically based on many repeated reports of experiences that occurred before a signal (Linz et al. 2018; Smallwood et al. 2009). Although this methodology has large benefits, it has some potentially serious limitations as well. The assessment is not a real-time assessment of ongoing experience in a stimulus-free context. Especially in the context of a stimulus-free task, in which the mind may easily wander, retrospective reports may be inaccurate (Hurlburt and Heavey 2015; Van Calster et al. 2017). In addition, the signals prompting to report can create a disruption in the spontaneous activity, and when predefined response categories are applied, this may lead to underreported or misclassified phenomena when the appropriate response category is not available (Van Calster et al. 2017).

Another method that has already been used in older work has been called the “think aloud” procedure. During this procedure, participants are instructed to tell all their thoughts usually while performing a task, already applied by Watson in the early twentieth century and further elaborated upon by others (Ericsson and Crutcher 1991; Pennebaker et al. 1990). However, this procedure was usually confined to thoughts only in the context of a cognitive task, such as a mental arithmetic task. Procedures involving also other experiences in the absence of stimuli have also been designed, however again typically involving retrospective reports of experience

occurring some time after the experience (Fox et al. 2012; Hurlburt 2009; Lehmann et al. 1998; Reinsel et al. 1986). Recently, these two approaches have been combined in a neurophenomenological study, in which a free verbalization of momentary experience task was applied during a stimulus-free period to examine the brain's default mode activity (Van Calster et al. 2017).

It was hypothesized that meditators would not only score higher on self-report measures of mindfulness and introspective interest and insight but also on tasks assessing emotional self-awareness and momentary phenomenological reports, especially reflecting interoception. This effect was expected to be most pronounced in Zen and Vipassana meditators, compared to transcendental meditators, as introspection and interoception are more emphasized in the former meditation traditions.

Methods

Participants

Two groups of participants were approached: individuals with experience in various meditation forms and individuals with no experience with meditation or other potentially awareness enhancing practice (e.g., yoga, qi gong, and tai chi). Participants were recruited from meditation centers in the Zen, Vipassana, and transcendental meditation traditions in and around the city of Tilburg, Southern Netherlands. The centers were approached by telephone or e-mail to explain the study and ask if participants of their centers may be approached by letter. In addition, former students of a mindfulness-based stress reduction center in Tilburg were recruited by e-mail. Individuals with experience in meditation were included if they had more than 1 year of ongoing experience with meditation and were practicing meditation at least 3 days a week for at least 20 min per session.

Meditation-naïve participants were initially recruited via participants of the meditators group, who were asked to recruit someone with more or less the same demographic characteristics. Because many people of the meditators group were not able to find someone for the control group and because mean age of the meditators was above 50 years, additional participants were recruited at the university. Groups who followed art and science courses designed specifically for post midlife participants were approached to this end. The meditator and non-meditator groups were matched on age and sex and preferably also on education.

Individuals were excluded from the study if they were currently undergoing psychological treatment, having a cardiac disease or a severe visual or auditory impairment. Cardiac patients were excluded because of possible interference with

cardiovascular measurements during some tasks (not reported here).

Included were 82 participants: 35 meditators and 47 non-meditators. Of the meditators, most practiced Vipassana/mindfulness or transcendental meditation (see Table 1), had on average 19.6 ± 12.0 years of meditation experience (range 2–41 years), and practiced on average 5.50 ± 1.42 days per week (range 3–7) for 30.0 ± 13.9 min per session (range 20–45). The meditators and non-meditators appeared to be well-matched regarding age (mean = 53.6 ± 11.3 years) and sex (43, 54%, women) (Table 1). However, it appeared difficult to find meditators with lower than high professional education: only 1 was found, compared to 15 in the non-meditators group ($\chi^2(1) = 8.98, p = 0.003$). In addition, meditators reported more often to have experienced negative life events ($\chi^2(1) = 5.62, p = 0.02$) and to have had psychological problems in the past ($\chi^2(1) = 5.27, p = 0.02$). Therefore, in relevant analyses, these variables were controlled.

Procedures

By means of a letter, participants were informed that they would take part in a study about meditation, attention, and introspection. All participants provided informed consent and received a gift coupon of 20 euro.

Participants completed a series of questionnaires and performed tasks in a laboratory at Tilburg University. The experimental part lasted about 2 h and consisted of several tasks of which the behavioral report task was the first. Before the tasks, questionnaires were completed.

Measures

A form was completed with questions concerning demographics and other background information: age, sex, education level, history of psychological problems (e.g., anxiety, depression, burnout), and negative life events which had a “significant impact on one's life.” Education level was categorized into high (higher professional education or university education) and low (all other).

Self-Reported Mindfulness

The Five Facet Mindfulness Questionnaire (FFMQ) (Baer et al. 2006) was applied to assess five facets of self-reported mindfulness skills by the following subscales: noticing external and internal phenomena (Observe), ability to describe one's thoughts and feelings (Describe), acting with awareness (Actaware), letting go of unpleasant inner experience (Nonreact), and not judging one's thoughts and feelings (Nonjudge). The questionnaire consists of 39 items, all rated on a 5-point Likert scale ranging from 1 (never or very rarely true) to 5 (very often or always true). The five scales

Table 1 Participant characteristics: means and standard deviations or numbers and percentages

Variable	Meditators <i>N</i> = 35	Non-meditators <i>N</i> = 47	<i>t</i> or χ^2 value
Age	54.1 (9.0)	53.2 (12.7)	0.36
Female	19 (56%)	24 (52%)	0.11
High education ^a	33 (97%)	31 (67%)	8.98**
Meditation form and years of experience		—	
Vipassana (<i>N</i> = 15)	20.3 (9.7) years		
Zen (<i>N</i> = 3)	25.0 (18.3) years		
Transcendental (<i>N</i> = 11)	21.4 (12.6) years		
Combination (<i>N</i> = 5)	10.4 (13.0) years		
Negative life events	24 (71%)	19 (41%)	5.62*
Psychological problems	23 (68%)	18 (39%)	5.27*

^a High education is high professional education or university; * $p < 0.05$; ** $p < 0.01$

previously demonstrated adequate to good internal consistency, with alpha coefficients ranging from 0.75 to 0.91, and relationships between the scales and other variables were consistent with predictions in most cases (Baer et al. 2006). Also, the Dutch version has shown adequate reliability and validity (de Bruin et al. 2012).

Self-Reported Introspective Interest and Insight

The Balanced Index of Psychological Mindedness (BIPM) assesses the “interest and ability to be in touch with and reflect on one’s psychological states and processes” (Nykliček and Denollet 2009)(p. 32). The BIPM consists of 14 items measured on a Likert scale ranging from 0 (not true) to 4 (very much true). Per subscale, 7 items assess two variables: Interest (in introspection) and Insight. The subscales of the Dutch version show adequate internal consistency (Cronbach’s alpha of 0.76 for Insight and 0.85 for Interest), and test-retest reliability ($r = 0.63$ and $r = 0.71$, respectively) (Nykliček and Denollet 2009).

Emotional Awareness Task

The Levels of Emotional Awareness Scale (LEAS) (Lane et al. 1990) consists of 10 (brief version) to 20 scripts containing affective imaginary scenes involving interaction between the participant and another person. Participants indicate how they and the other person would feel in each situation. Responses are scored by raters using a standardized list of words on a scale of 0 (no emotion reported) to 5 (highest level of emotional awareness). Averaged scores across the scenarios subsequently reflect the variables emotional Self-awareness, emotional Other-awareness, and a total awareness score. Reliability (interrater reliability of 0.84) and validity have been shown to be adequate (Lane et al. 1990). For the purpose of this study, the LEAS was translated by means of the back-translation method into Dutch. Because of unsuitability of

some items for the Dutch situation, we selected 10 scenarios which would (i) cover the range of situations and emotions from the original and (ii) would fit the Dutch situation. Subsequently, respondents’ answers were rated by two independent raters to evaluate its reliability. The intraclass correlation between the two raters was 0.68 for awareness of own emotions (Self-awareness), 0.80 for awareness of others’ emotions (Other-awareness), and 0.70 for the total score.

Monitoring of Momentary Experience Task

A version of the “think aloud” procedure (Ericsson and Crutcher 1991; Van Calster et al. 2017) was applied. Participants received the following instructions on a computer screen: (i) “For the next three minutes, please describe what, at the moment, you are experiencing/what is going through your mind. In this task there is no right or wrong, it’s all about your own experience. However, try to speak frankly (all information will be treated confidentially). The task will start straight-away”, after which the second instruction appeared: “You can start talking now. Describe simply what you are experiencing / what is going through your mind at the moment.” During the task, the last instruction stayed visible as well as a screen time beam that counted off the 3 min. The instruction was kept brief, without further explanation not to prompt a certain mode of attentiveness or awareness, but to let the more automatic tendency of that moment get expressed. While performing the task, participants were recorded on video for later scoring of their reports. Participants were told that this was done only to be able to score their answers afterward.

The transcribed reports were coded for presence of one of several categories. First, the transcriptions were divided into meaningful semantic units, consisting of words together forming a new piece of information compared to the preceding three units. Usually, this is a part of a sentence. These units were subsequently scored into mutually exclusive categories, relevant to awareness of present-moment phenomena

(Hurlburt and Heavey 2015; Van Calster et al. 2017; Vanhaudenhuyse et al. 2011), based on content analysis (Neuendorf and Skalski 2002): (i) thoughts. These were subdivided into thoughts about the present, the past, and the future (e.g., “tomorrow I will go to the movies”), (ii) current affective states (affective states without any reference to their expression in the body, e.g., “I feel annoyed”), (iii) current bodily sensations (e.g., “I feel my relaxed muscles”), and (iv) current exteroceptive perceptions (e.g., “I see this white monitor”). The scoring of the expressions into categories was performed by two independent raters. These were two undergraduate students of psychology, who were trained by the author to score expressions using a written manual, scored examples, and practice transcripts with feedback. The training time was approximately 5 h. The following variables were operationalized besides Thinking (the number of thoughts reported): (i) Interoception (the number of reported bodily sensations); (ii) Exteroception (the number of reported exteroceptive perceptions); and (iii) Affect (the number of reported affective states).

Social Desirability

The tendency to give overly positive answers was assessed by the Repressive Defensiveness scale of the Weinberger Adjustment Inventory (Weinberger and Schwartz 1990) to assess associations of the other instruments with this tendency. It has 11 items reflecting mild undesirable, but common behaviors, like “Once in a while I say bad things about people that I would not say in front of them” and “Once in a while I say things that are not completely true.” The items are scored on 5-point Likert scales ranging from 1 (completely disagree) to 5 (completely agree). The Cronbach’s alpha of the original version is 0.76, while 2-week test-retest reliabilities were 0.75–0.88, and validity is also established (Turvey and Salovey 1994; Weinberger and Schwartz 1990). The Dutch version, consisting of 9 items, has a Cronbach alpha’s of between 0.76 and 0.83 and substantial correlation with another measure of social desirability (Nyklíček et al. 1998).

Data Analyses

Data were analyzed using SPSS version 24. First, exploratory Pearson product moment correlations were computed between the dependent variables to evaluate their interrelations. This is especially valuable as one of the measuring instruments is new. Although this involved 40 correlations, no correction for multiple comparison was applied because the aim of these correlations was only to provide a background for the interpretation of the analyses related to the hypotheses. To test the hypotheses, differences between groups regarding the relevant self-awareness-related variables were tested using independent samples *t* tests and covariance analyses (ANCOVAs).

In the ANCOVAs, differences between groups were adjusted for relevant variables on which groups differed, potentially including age, sex, level of education (high/low), history of psychological problems (yes/no), and negative life events (yes/no).

Given the multiple ANCOVAs performed, α values were adjusted using the Benjamini-Hochberg procedure with a 10% false discovery rate (FDR) (Thissen et al. 2002). The computation was using the 11 variables the hypotheses refer to: 5 FFMQ subscales, 2 BIPM subscales, 1 from the LEAS assessing emotional self-awareness, and 3 momentary self-monitoring variables from the behavioral task.

Results

Monitoring of Momentary Experiences Task

The mean number of scored entries across participants ranged between 0.94 (SD = 0.94) in non-meditators and 2.06 (SD = 2.36) in meditators for exteroceptive phenomena to about 16 for all thoughts in both groups. The number of scored entries did not differ between the two raters per category ($t(162) < 1$, $p > 0.10$). Intraclass correlations between scores of the two raters were as follows: 0.84 (thoughts about the present), 0.95 (thoughts about the past), 0.88 (thoughts about the future), 0.71 (affects), 0.84 (bodily sensations), 0.81 (exteroceptions), and 0.94 (all categories). To enhance parsimony, the three different thinking categories were summed into one Thinking variable. Regarding distribution of the resulting variables, however, almost all categories showed highly skewed and dense (kurtosis) distributions. Therefore, square root transformations were applied, resulting in acceptably normal distributions (both skewness and kurtosis < 1). These transformed variables were used in all further computations.

Exploratory Associations Between Constructs

Correlations between the self-report mindfulness variables and the momentary self-monitoring task variables were largely absent, except the expected correlation between Observe and Exteroception ($r = 0.28$, $p = 0.013$) and between Describe and Thinking ($r = 0.28$, $p = 0.011$).

Regarding other variables, introspective Interest correlated significantly with some momentary self-monitoring variables, especially with Interoception ($r = 0.36$, $p = 0.001$). The same holds for emotional Self-awareness ($r = 0.45$, $p < 0.001$ with Interoception). However, because 40 correlations were performed between the dependent variables, an occasional significant correlation may have been due to chance. No correlations were obtained with social desirability (Table 2).

Differences Between Meditators and Non-Meditators

Meditators scored higher on self-reported mindfulness facets compared to non-meditators, except for acting with awareness (Table 3). When controlling for age, sex, education, and history of life events and psychological problems, these differences remained significant, except for Describe ($p = 0.07$, partial $\eta^2 = 0.04$), effect sizes being medium to large.

The largest difference between the groups was found on Nonreact ($F(1, 72) = 17.45$, $p < 0.001$, partial $\eta^2 = 0.195$). Even larger difference between groups was found on the introspective Interest subscale of psychological mindedness ($F(1, 72) = 32.18$, $p < 0.001$, partial $\eta^2 = 0.315$). Of the covariables, sex showed a significant association with Nonreact ($F(1, 72) = 8.79$, $p = 0.004$, partial $\eta^2 = 0.109$) and education with Interest ($F(1, 72) = 4.63$, $p = 0.035$, partial $\eta^2 = 0.062$): women scored lower on Nonreact compared to men, and higher educated people scored higher on Interest compared to lower educated participants.

There was no difference between meditators and non-meditators regarding the number of entries ($p > 0.10$) or reported thoughts ($p > 0.10$) in the momentary experiences task. Meditators did score higher on most momentary self-monitoring variables: Interoception ($t(80) = 3.84$, $p < 0.001$), Affect ($t(80) = 2.19$, $p = 0.03$), with a trend for higher Exteroception ($t(80) = 1.85$, $p = 0.07$). When controlled for age, sex, education, history of psychological problems and life events, Interoception remained the only variable significantly differing between groups ($F(1, 72) = 6.79$, $p = 0.01$, with highest FDR adjusted $\alpha = 0.045$, partial $\eta^2 = 0.086$). Of the covariables, only history of psychological problems showed a significant association with Exteroception ($F(1, 72) = 7.22$, $p = 0.009$, partial $\eta^2 = 0.091$): those with past psychological problems showing higher scores.

No differences between groups were found on the Levels of Emotional Awareness Scale.

Differences Between Meditation Forms

When these analyses were restricted to only the 15 mindfulness/Vipassana meditators versus non-meditators, the differences regarding Interoception and Exteroception were also significant ($t(60) > 4.30$, $p \leq 0.001$). These effects remained significant when controlled for demographic variables and history of life events and past psychological problems ($F(1, 53) > 9.61$, $p \leq 0.003$, partial $\eta^2 > 0.15$). Of the covariables, again, only history of psychological problems predicted Exteroception ($p < 0.01$).

When comparing mindfulness/Vipassana and TM meditators (the other categories contained too few participants), the mindfulness meditators scored higher on Interoception and Exteroception ($t(24) > 2.93$, $p < 0.008$). These effects remained significant showing large effects, when controlling for history of

psychological problems, which was the only covariable which was associated with one of the self-monitoring variables: $F(1, 23) = 7.88$, $p = 0.010$, with highest FDR adjusted $\alpha = 0.027$, partial $\eta^2 = 0.26$ for Interoception and $F(1, 23) = 11.99$, $p = 0.002$, partial $\eta^2 = 0.34$, for Exteroception (Table 4).

Interestingly, when compared on the self-report instrument for mindfulness, these subgroups did not differ, except significantly on Nonjudge ($F(1, 23) = 8.93$, $p = 0.007$, partial $\eta^2 = 0.28$) with a nonsignificant trend for Nonreact ($F(1, 23) = 3.81$, $p = 0.063$ with FDR adjusted $\alpha = 0.036$, partial $\eta^2 = 0.14$): TM scored higher on these mindfulness variables than mindfulness/Vipassana meditators (Table 4). In this analysis, education was the only variable showing an association with self-reported mindfulness and adjusted for. No differences were found on the other variables.

Discussion

The aim of the present study was to explore aspects of self-awareness of experienced meditators, using a multi-method approach consisting of tests ranging from self-report to scenario and behavioral tasks. Regarding evaluative self-report instruments, as expected, the experienced meditators scored higher on introspective interest and several mindfulness skills, compared to controls. These effects remained significant when adjusted for demographic characteristics, previous life events, and psychological problems. Regarding the monitoring of momentary experiences task, meditators showed higher interoception scores compared to controls. This effect was also anticipated as during many forms of meditation, attention is directed at interoceptive phenomena, such as breathing sensations. Because this focus is less clear in TM, it was expected that meditators of this tradition would show lower scores on interoception compared to the other meditators. Indeed, lower scores were found on this measure, when comparing TM with the mindfulness/Vipassana group.

The finding that the mindfulness/Vipassana meditators did not score higher on self-reported mindfulness skills compared to TM practitioners deserves some comments. In fact, TM practitioners scored significantly higher on nonjudging one's thoughts and feelings with a tendency for the same effect for nonreacting to one's unpleasant thoughts. The absence of higher scores in mindfulness meditators compared to TM is consistent with studies showing (a) no difference between mindfulness and TM on self-reported mindfulness (Schoormans and Nyklíček 2011), and (b) TM enhancing self-reported mindfulness scores (Tanner et al. 2009). The speculation that TM may enhance mindfulness skills in an implicit way by accepting and not getting involved in one's thoughts and emotions while being attentive to the performance of the mantra rehearsal seems plausible. Whatever the mechanism may be, these studies together with the present study show the added value of the inclusion of self-

Table 2 Reliability and correlations between spontaneous momentary experience reports and other psychological variables

	Reliability	Interoception	Exteroception	Affect	Thinking
FFMQ: Observe	0.76	0.19 [#]	0.28 [*]		
FFMQ: Describe	0.91	0.19 [#]	0.20 [#]		0.28 [*]
FFMQ: Actaware	0.85				
FFMQ: Nonjudge	0.84				
FFMQ: Nonreact	0.77				
BIPM: Interest	0.85	0.36 ^{**}		0.24 [*]	
BIPM: Insight	0.77				0.21 [#]
LEAS: Self-awareness	0.68	0.45 ^{***}	0.20 [#]	0.24 [*]	
LEAS: Other-awareness	0.80	0.21 [#]			
LEAS: Total awareness	0.70	0.39 ^{***}			
Social desirability	0.78				

Scores of momentary experience reports are square root transformed; *FFMQ* Five Factor Mindfulness Questionnaire; *BIPM* Balanced Index of Psychological Mindedness; *LEAS* Levels of Emotional Awareness Scale; Reliability = Cronbach's alpha for all constructs except the LEAS scales (intraclass correlation between two raters); * $p < 0.05$; # $p < 0.10$ (r with $p > 0.10$ are not shown)

awareness-related measures based on methods other than evaluative self-report, enabling uncovering differences which would remain obscure otherwise.

The absence of a difference between groups on emotional self-awareness as assessed by the LEAS was not anticipated, as both introspection and interoception, generally part of most meditation forms, would be expected to enhance emotional self-awareness (Kever et al. 2015; Terasawa et al. 2014). However, it should be noted that the LEAS assesses one's imagined emotional reaction to scenarios. It may be speculated that a potentially enhanced emotional awareness may have

been counteracted by the putative effect of equanimity claimed for most meditation practices (Desbordes et al. 2015).

To put the variables of the current monitoring of momentary experience task into perspective, 40 explorative correlations were computed between the task variables and variables of existing measures. First, correlations were obtained with emotional self-awareness as measured by the LEAS. As discussed above, this may have been expected as emotional self-awareness may be viewed as a result of meditation practice. Interestingly, this association was predominantly found for interoception, not affective reports. As interoceptive

Table 3 Estimated marginal means (and standard errors) of meditators and non-meditators, controlled for sex, age, education, major life events, and previous psychological problems

Variable	Meditators (<i>N</i> = 35)	Non-meditators (<i>N</i> = 47)	<i>F</i> value	Partial η^2
FFMQ: Observe	30.38 (1.52)	26.76 (1.21)	8.79 ^{**}	0.11
FFMQ: Describe	29.43 (2.11)	26.34 (1.68)	3.33 [#]	0.04
FFMQ: Actaware	27.20 (1.63)	26.66 (1.30)	0.17	0.00
FFMQ: Nonjudge	32.79 (1.74)	28.92 (1.39)	7.66 ^{**}	0.10
FFMQ: Nonreact	26.50 (1.22)	22.40 (0.97)	17.45 ^{***}	0.20
BIPM: Interest	23.53 (1.60)	16.22 (1.27)	32.18 ^{***}	0.32
BIPM: Insight	22.66 (1.47)	21.35 (1.17)	1.21	0.02
LEAS: Self-awareness	2.47 (0.13)	2.33 (0.10)	1.77	0.03
LEAS: Other-awareness	2.34 (0.15)	2.40 (0.12)	0.28	0.00
LEAS: Total awareness	2.95 (0.11)	2.87 (0.09)	0.81	0.01
Interoception	1.46 (0.33)	0.77 (0.26)	6.09 [*]	0.09
Exteroception	0.57 (0.24)	0.47 (0.20)	0.23	0.00
Affect	1.15 (0.23)	0.85 (0.18)	2.67	0.04
Thinking	3.42 (0.42)	3.68 (0.34)	0.58	0.01
Social desirability	33.79 (2.95)	27.62 (2.35)	6.72 [*]	0.09

* $p < 0.05$; ** $p < 0.01$; # $0.05 < p < 0.10$; hypotheses-related variables are in boldface; momentary experience reports variables are square root transformed; *FFMQ* Five Factor Mindfulness Questionnaire; *BIPM* Balanced Index of Psychological Mindedness; *LEAS*, Levels of Emotional Awareness Scale

phenomena may be more salient and changing in this brief context compared to affects, this outcome may not be too surprising. In addition, it is known that somatosensory phenomena and affect are closely linked (Adolphs et al. 2000; Rudrauf et al. 2009). However, one must note that because of the number of correlations performed without correction for multiple comparisons, an occasional significant correlation may have been due to chance.

The mostly absent exploratory associations between the momentary experiences reports and self-reported mindfulness as assessed by the FFMQ are noteworthy. Only the Observe facet of the FFMQ showed a significant association, namely, with momentary exteroceptive reports. This correlation could have been expected as most items of the Observe subscale relate to observing sensory, albeit especially exteroceptive, stimuli (Baer et al. 2006). The absent correlations with acting with awareness, nonjudging, and nonreacting facets of the FFMQ might also not be surprising as these mindfulness facets are not assessed by the monitoring of momentary experiences task. The describing facet correlated with the number of reported thoughts, but not with other reports. This may reflect the strong verbal orientation of both. It may be clear that the FFMQ and the momentary experiences task assess different phenomena, which may be seen as complementary in meditation and awareness research.

Limitations and Future Research

A number of limitations of this study have to be acknowledged. Obvious limitations include the relatively small sample size, the heterogeneity of the meditator sample, and the cross-sectional nature of the data collected at one measurement time,

not permitting any conclusions along causal lines. In addition, despite the assumption that the verbal reports in the behavioral task are mainly driven by selective attention reflecting subsequent awareness (Lachter et al. 2004; Van Calster et al. 2017; Vanhaudenhuyse et al. 2011), it cannot be excluded that some forms of reporting bias may have occurred, such as due to social desirability or habitual tendencies. The behavioral task variables did not show any association with a measure of social desirability in the current study, suggesting that this bias may be limited in the present context. As the task consists of the mere reporting of the current experience, which is multifaceted, habitual tendencies not related to social desirability in this context probably mainly reflect attentional tendencies. As attention and awareness are trained in meditation, these attentional tendencies (e.g., to attend or not to attend to bodily sensations) are expected to change with meditation. Therefore, reflection of these tendencies in the scores of the present task is a welcome part of the measure. Nevertheless, future research should examine factors potentially biasing the scores on this task. Finally, the sequence of tasks was not counterbalanced. It cannot be excluded that this somehow has influenced the associations found. Future studies should mainly involve larger samples retesting associations found in the present study and longitudinal or experimental designs to study temporal dynamics and to be able to draw conclusions about causality of the associations.

It is concluded that the total experienced meditator group differed from non-meditators on various aspects of self-awareness, both as assessed by evaluative self-report trait-like measures and by a behavioral task during which spontaneous momentary experiences are monitored. The behavioral measure showed added value when comparing meditation subgroups,

Table 4 Estimated marginal means and standard errors of meditators in the Vipassana/ mindfulness and transcendental meditation traditions

Variable	Mindfulness/Vipassana (<i>N</i> = 15)	Transcendental meditation (<i>N</i> = 11)	<i>F</i> value
FFMQ: Observe	27.33 (2.34)	25.50 (2.10)	1.26
FFMQ: Describe	22.75 (2.39)	20.25 (2.14)	2.24
FFMQ: Actaware	21.20 (2.80)	23.60 (2.51)	1.51
FFMQ: Nonjudge	28.57 (2.46)	33.70 (2.21)	8.93**
FFMQ: Nonreact	21.55 (2.13)	24.45 (1.91)	3.81 [#]
BIPM: Interest	20.58 (2.56)	19.35 (2.28)	0.47
BIPM: Insight	20.48 (3.00)	20.45 (2.67)	0.00
LEAS: Self-awareness	2.30 (0.22)	2.20 (0.19)	0.48
LEAS: Other-awareness	2.01 (0.22)	1.92 (0.20)	0.35
LEAS: Total awareness	2.74 (0.18)	2.49 (0.16)	3.95 [#]
Interoception	2.36 (0.34)	0.99 (0.37)	7.88**
Exteroception	1.70 (0.75)	0.57 (0.86)	11.99**
Affect	1.26 (0.18)	1.26 (0.20)	0.00
Thinking	3.55 (0.34)	3.96 (0.38)	0.70

* $p < 0.05$; ** $p < 0.01$; [#] $0.05 < p < 0.10$; controlled for significant covariables (education or previous psychological problems); hypotheses-related variables are in boldface

yielding a difference in momentary interoceptive and exteroceptive experience reports, which was not visible when using only the self-reports. Future studies should examine to what extent this measure assesses a purely momentary state, a skill that can be learned, or a trait that is reflected in momentary performance. Whatever the outcome of those studies, behavioral tasks may be of importance to include in future meditation and self-awareness research.

Compliance with Ethical Standards

Conflict of Interest The author declares that he has no conflict of interest.

Ethical Approval All procedures performed in the studies were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments. Ethical approval for the study was obtained from the Institutional Review Board of Tilburg University.

Statement of Informed Consent Informed consent was obtained from all individual participants included in the study.

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